



Helena Wastewater Collection System Master Plan

CHAPTER 3

BASIS OF PLANNING

3.1. INTRODUCTION

This basis of planning chapter is intended to define the existing and future conditions within the planning area so that wastewater collection system needs can be identified. The planning period is 20 years, ending in 2025. This planning period coincides with the recently completed 2005 Helena Water Facilities Plan.

In order to be consistent with planning efforts that the City has recently undertaken and completed, including the 2005 Helena Water Facilities Plan and the 2004 Helena Transportation Plan, the planning area as well as population projections and land use patterns from these reports have been adopted for this master plan. They are summarized in this chapter.

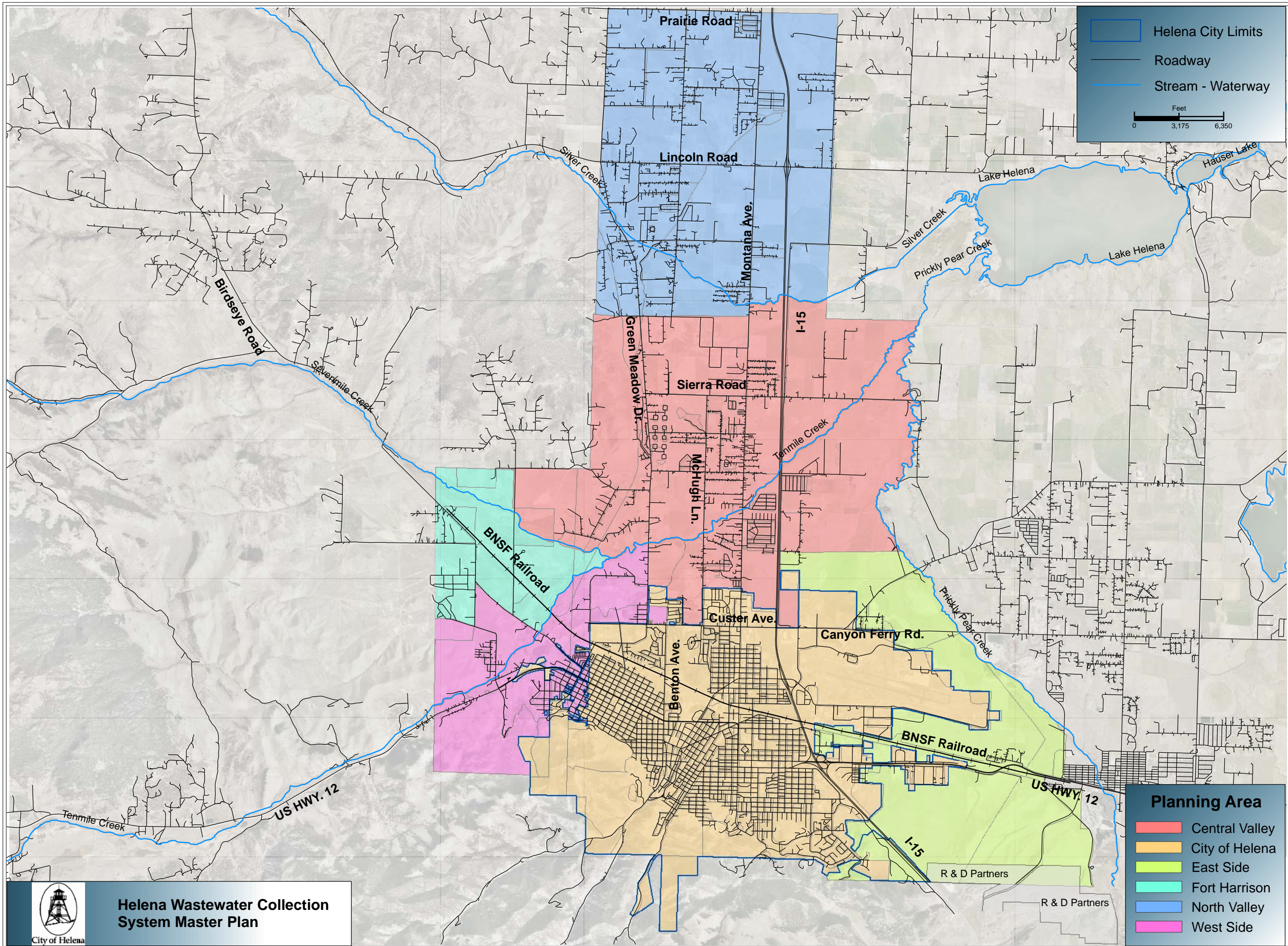
Current flows have been derived from historic and recent flow records from the wastewater treatment plant flow and supplemented with flow monitoring performed as part of this study in 2006. From that information, coupled with the population projections, future flows are estimated.

3.2. CURRENT AND FUTURE SERVICE AREA

The City of Helena's current wastewater service area includes the current City limits of Helena and the Fort Harrison Area. Currently, sewer service is provided within the City limits as well as a limited number of connections outside of the City limits.

Similar to the 2005 Water Master Plan, the future collection system service area has been defined to include the North Valley, Central Valley, East Side and West Side in addition to the existing City limits and Fort Harrison. The planning area is shown in Figure 3-1. A short description of each service area is provided in the following sections.

The study area includes approximately 37,400 acres and extends over 7.5 miles north of the existing Helena City limits. The northern boundary of the study area coincides with Prairie Road while the southern boundary extends to the Jefferson County line with the exception of one parcel which is contiguous to property currently being developed in the southeastern portion of the study area and belongs to a single landowner. The east side of the study area extends to the western edge of East Helena's City limits and



extends north. The west side of the study area terminates approximately one and a half miles west of the existing Helena City limits.

Table 3-1 Helena Wastewater Collection System Future Service Areas	
Service Area	Area (acres)
City of Helena	9,607
East Side	5,800
Central Valley	9,646
North Valley	7,684
West Side	2,859
Fort Harrison	1,802
Total	37,398

3.2.1. *West Side Service Area*

A portion of the West Side service area was the subject of the 2002 Helena West Side Infrastructure Study. It is included in the Helena West Side Census Designated Place (CDP) as defined by the Montana Department of Commerce for 2000 census purposes. The west side can be characterized as predominantly residential with less than 10 percent commercial and industrial development.

Portions of the West Side Service Area adjacent to the City limits have some City services, including a mix of water, sewer or both. Some of the services were extended outside of the City limits as early as the 1930's, prior to the current annexation policies. More recently, water and sewer services have been extended with the condition that the property owner loses the right of refusal for annexation when it is proposed.

3.2.2. *Fort Harrison Service Area*

The Fort Harrison Area was connected to the City when their wastewater lagoons failed. Sewer flows from the Fort and the VA Hospital gravity flow to the discharge pipe of the lagoons where it flows through the Fort Harrison gravity main to the Fort Harrison lift station and is pumped into the Helena collection system on Custer Avenue.

3.2.3. *Central Valley Service Area*

The Central Valley Service Area is bounded by the City limits on the south, the North Valley Service Area on the north, Prickly Pear Creek on the east and the Scratch Gravel Hills area on the west. Portions of the service area are contained in both the Helena Valley NE CDP and the Helena Valley West Central CDP. It can be characterized as low density residential and commercial with scattered medium to high density subdivisions primarily along the North Montana Avenue corridor.

3.2.4. North Valley Service Area

The North Valley Service Area is bounded by the Central Valley Service Area on the south and extends two miles north of Lincoln Road. The west boundary is the scratch Gravel Hills Area and the east boundary is approximately one-half mile east of Interstate 15. The Helena Valley NW, Helena Valley West Central and Helena Valley NE CDPs bisect the service area. It is similar to the Central Valley Service Area with medium to high density residential subdivisions along the North Montana Avenue and Lincoln Road corridors.

3.2.5. East Side Service Area

The East Side Service Area is bounded by the City limits on the east, the Central Valley Service Area on the north, Prickly Pear Creek and the City of East Helena on the east and the county line on the south. The East Side Service Area is contained in the Helena Valley Southeast census designated place as defined by the Montana Department of Commerce for 2000 census purposes. The east side contains a larger proportion of industrial development than the other service areas. Two of the largest proposed residential developments are located in the East Side Service Area.

3.3. POPULATION AND LAND USE

3.3.1. Introduction

Current and projected population data is required in order to evaluate the existing wastewater collection system capacity and to assist in planning for future capacity needs. A review of land use patterns is also an important component of a thorough capacity analysis.

Recent master planning efforts undertaken by the City included an extensive analysis of population trends. The results of those efforts have been incorporated into this master plan and updated based on updated 2005 census population projections.

3.3.2. Existing Population Projections

Four sources of data were used to develop the population projections for this Master Plan. They include the *2005 Helena Water Master Plan*; the *2004 Helena Transportation Plan*; the 2000 census, updated to 2005 and projected to 2025; and preliminary design information for key subdivisions currently in the planning phase within the study area. For reference, Figure 3-2 shows the Transportation Area Zone (TAZ) areas, with census blocks, overlapping Census Designated Place boundaries, key subdivisions within the study area, and the Helena Wastewater Collection System Service Areas.

2005 Water Master Plan Population Projections. Population projections used for the *2005 Water Master Plan* are shown in Table 3-2. The population data were based on estimates originally developed in the *1998 Wastewater Treatment Plan* and verified

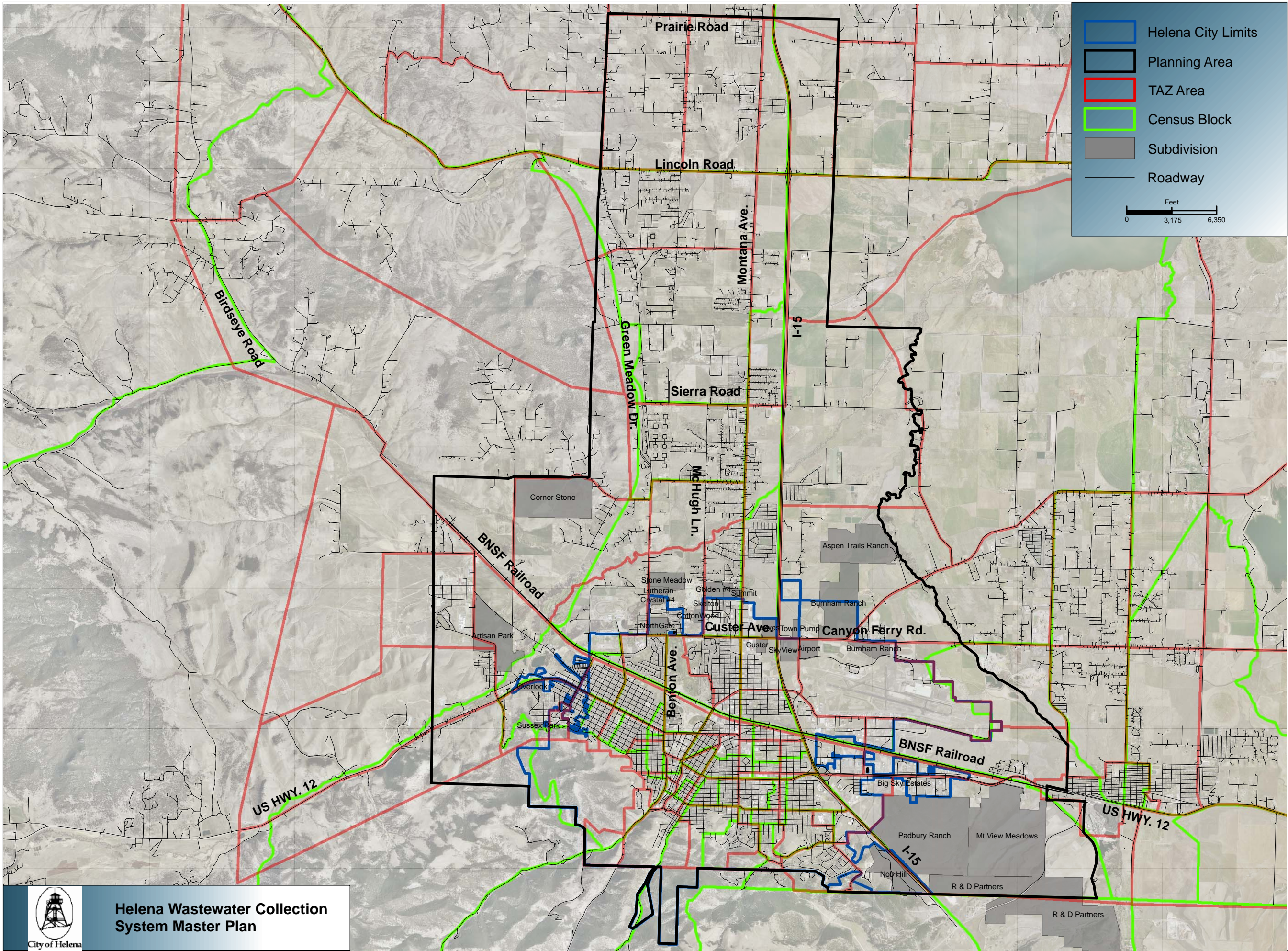
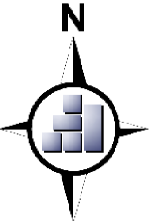


Figure 3-2
Planning Area, Planned Subdivisions,
TAZ, and Census Boundaries

Helena Wastewater Collection System Master Plan



Helena Wastewater Collection
System Master Plan

by the high growth scenario projections developed in the *2004 Helena Transportation Plan*.

Table 3-2 2005 Water Master Plan Population Projections			
Service Area	2004	2025	Buildout
City of Helena	31,005	35,986	40,493
East Side	Not reported		
Central Valley	330	9,670	15,166
North Valley	0	853	4,588
West Side	540	3,300	4,060
Fort Harrison	162	212	258
Service Area Population	32,037	50,021	64,565

It is important to note that the 2005 Water Master Plan did not use the 2000 census information. The 1990 – 1999 population projections published by the U.S. Census Bureau (Population Estimates Program, Population Division, U.S. Census Bureau, Washington, DC 20233) used a projected growth rate for Helena of 16 percent over that 10 year period. The 1998 HAWT study as well as the 1993 Transportation Plan on which the 1998 population projections were based, used the U.S. Census Bureau assumption of 16 percent growth. This assumption, projected to 2004, resulted in an estimated population of 31,005 for the City of Helena.

However, the 2000 census showed a 2000 population within the City of Helena of 25,780 with an actual growth rate of 4.54 percent for the decade compared to the 16 percent projected in the previous decade. This is only a 1,171 person increase in the 1990 population within the City limits; much less than the predicted 4,937 increase. Nonetheless, the population projections for 2025 used in the 2005 Water Master Plan tracked well with the “high growth scenario” reported in the *2004 Helena Transportation Plan*.

2004 Helena Transportation Plan Population Projections. The *2004 Helena Transportation Plan* undertook an extensive population analysis as part of the travel demand forecasting. The study area for that plan is much larger than the wastewater service area; however, the 2004 plan utilized smaller transportation analysis zones (TAZ) as well as census block data. Detailed analysis of current and future land use was developed by TAZ area and then broken down even further to the census block level and future population for each census block was estimated. Population trends were developed on a county basis. The 2004 plan reported the 2005 population of Lewis & Clark County as 60,153 and a 2025 county population of 90,593 under the high (50%) growth scenario.

Those projection calculations broken down by TAZ area were obtained from Robert Peccia and Associates and utilized in developing the population projections for this Collection System Master Plan. The transportation plan incorporated the 2000 census results into the reported population projections. The high growth scenario used in the *2004 Transportation Plan* was utilized since it best reflects the growth pattern trends that were realized in the mid 1990’s to early 2000’s (Robert Peccia & Assoc, 2004).

2000 Census and U.S. Census Bureau Population Projections. The 2000 census provided more detailed population data for the Helena area than had been provided in previous 1990 census estimates. Census designated places (CDPs) for populated areas outside of incorporated cities and towns were identified and analyzed in the 2000 census. The wastewater service area includes portions of six CDPs. The number of households and total population were reported for all CDPs from which a population per household can be calculated. That information was used in conjunction with census block data to estimate current and future population within the service area.

Preliminary Design Information for Key Subdivisions. The City is aware of numerous subdivisions that are in various stages of planning and development within the planning study area. For some of these subdivisions, data defining the anticipated development densities and population is available and represents a much more accurate estimate of future development than any of the three previously described data sources. Therefore, data from ten different subdivisions was used to supplement the other data sources and provide a level of accuracy that would not have been attained through the use of the other more broad brush planning data sets.

Once the four different data sources had been collected, the data was compiled into a Geographic Information System (GIS). The GIS provided a powerful tool by which the areas defining the subdivisions, the census blocks, and the service areas could all be stacked together to determine the cumulative effect on future population. As part of this analysis, each different data set is cut into other data sets with a cookie cutter type of process so that the relevant population data is used and the other data is eliminated. This process was used to determine the estimated population without double counting the data from all the data sources.

3.3.3. *Existing and Projected Population Conditions*

Based on the analysis described in the previous section, population projections by service area were developed for use in this Master Plan. They are shown in Table 3-3 below.

Table 3-3 Wastewater Service Area Population Projections¹				
Service Area	2005	2010²	2015	2025
City of Helena	27,484	28,495	29,509	32,167
East Side	1,034	2,793	4,702	4,993
Central Valley	6,293	8,724	11,245	12,523
North Valley	3,538	4,153	4,769	6,202
West Side	1,590	2,801	4,061	4,695
Fort Harrison	63	70	77	91
Service Area Population	40,002	47,036	54,363	60,671
¹ Population estimates determined from high growth scenario of 2004 Greater Helena Area Transportation Plan using TAZ and census block areas within the Wastewater Collection System Service Areas.				
² Population estimate based on a straight line interpolation of population estimates between 2005 and 2015 for TAZ areas.				

3.3.4. Existing Land Use Conditions

Every community is unique in terms of its wastewater flows and loads. Characteristics that provide for variation in flows and loading are related to the type of user. For example, some communities have large industrial users which generate high wastewater flows and can sometimes contribute high wastewater loading at the plant. Other communities may have little or no industrial users and be predominantly residential connections. Helena can be characterized as having a relatively significant number of commercial users with limited industrial activity, and as being the home of State of Montana government facilities and Carroll College.

The Land use categories and associated acreage based on the 2005 zoning information from the City-County GIS database is summarized in Table 3-4. Figure 3-3 shows the various types of land use in the City of Helena service area.

Table 3-4 Helena Land Use		
Land Use Category	Area (acres)	Percent of Total Area
Airport	4,697	12.3%
Central Business District	226	0.6%
Commercial Light Manufacturing District	2,696	7.1%
General Commercial District	935	2.5%
High Density Residential District	170	0.4%
Manufacturing & Industrial District	768	2.0%
Medium Density Residential District	2,888	7.6%
Neighborhood Business District	75	0.2%
Open Space	3,215	8.4%
Planned Unit Development	954	2.5%
Public Lands & Institutions District	9,682	25.4%
Residential – Office District	769	2.0%
Single Family Residential District	6,686	17.5%
Single Family Residential District – Large Lot	3,732	9.8%
Transitional – Commercial Light Manufacturing District	30	0.1%
Transitional – General Commercial District	52	0.1%
Transitional – Residential – Office District	77	0.2%
Transitional – Medium Density Residential District	439	1.2%
Transitional – Single Family Residential District	9	0.02%
Total	38,100	100%

The breakdown of zoning by category shows that residential areas comprise 41 percent of the planning area, with 23 percent commercial (including the Airport), 2 percent industrial, 8 percent open space, and 25 percent zoned as public lands and institutions.

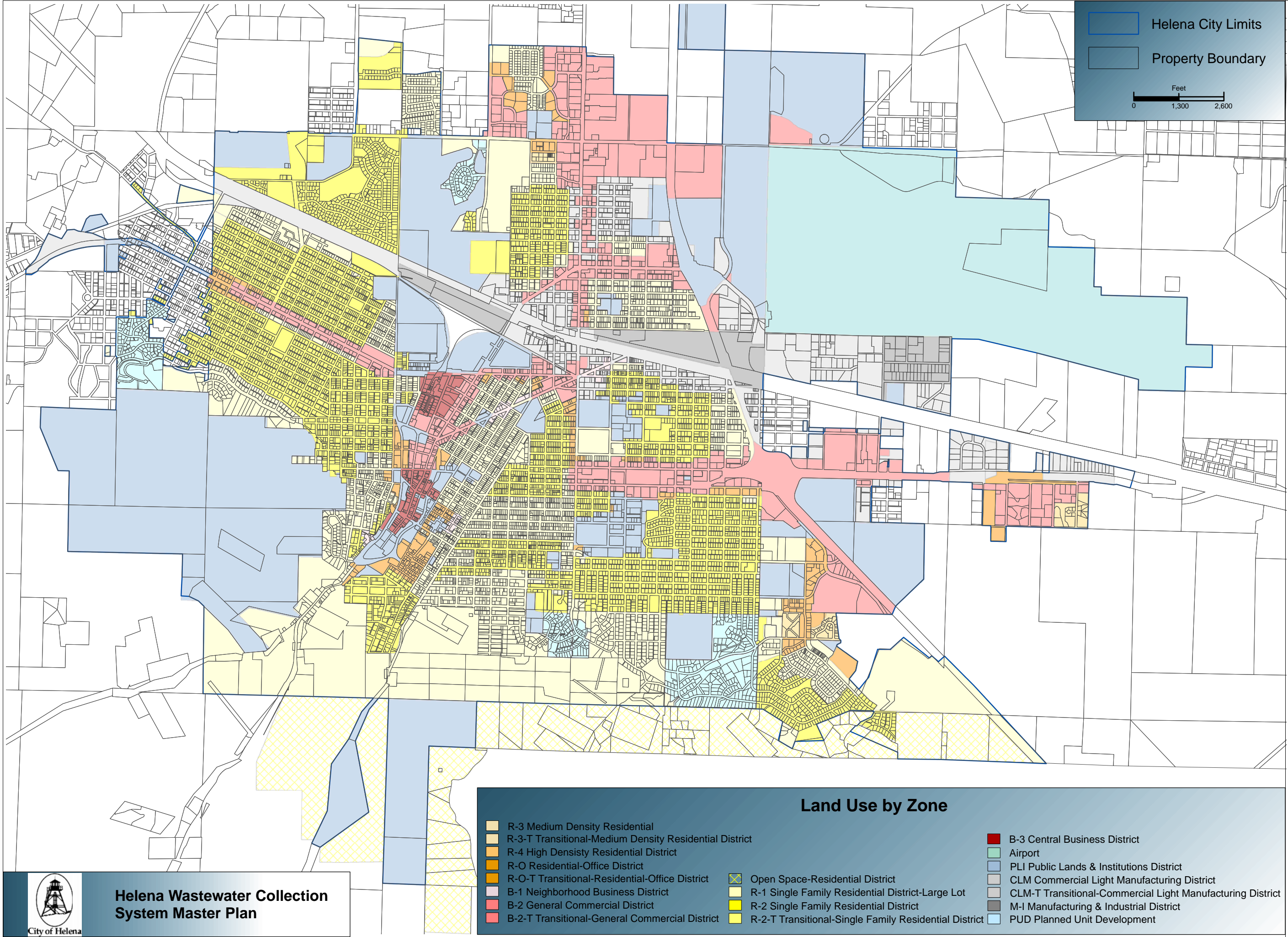


Figure 3-3
City of Helena
Land Use Zoning
Helena Wastewater Collection System Master Plan

3.4. WASTEWATER FLOWS

3.4.1. *Introduction*

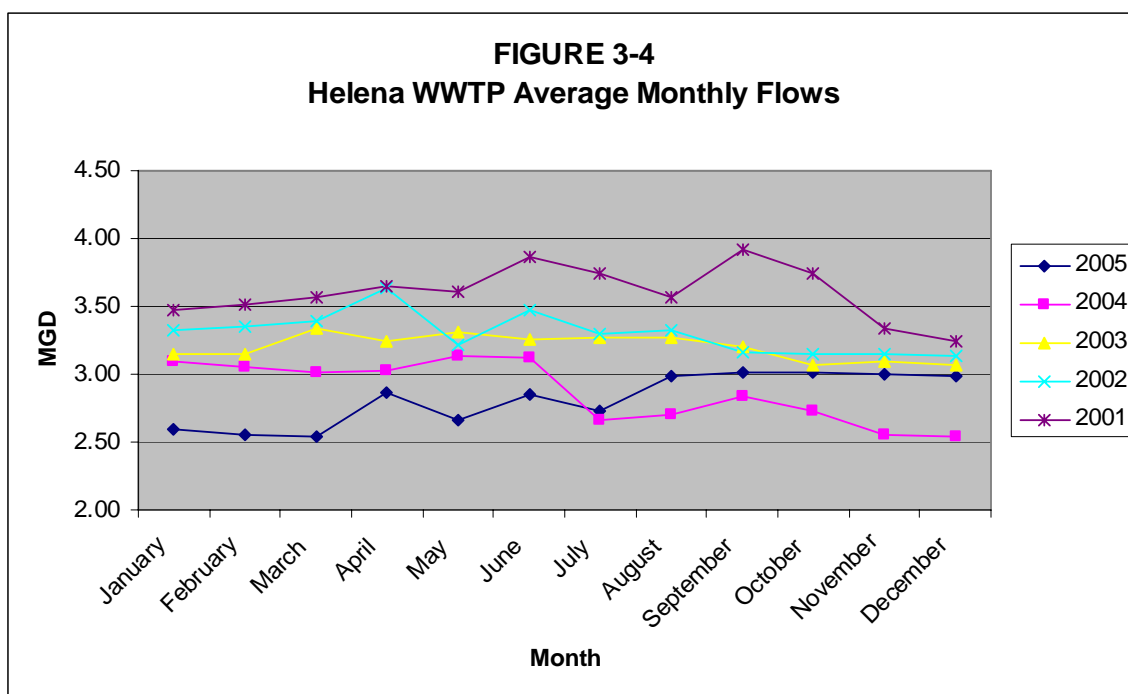
This section is intended to provide a brief summary of historic wastewater flows and establish a basis for predicting future flows. It should be noted that an evaluation of the nutrient loads in the wastewater is not part of this Master Plan and will be addressed in a future Wastewater Treatment Facilities Plan.

3.4.2. *Historic Wastewater Flows*

The City of Helena maintains wastewater flow records based on a flow meter located in the headworks of the wastewater treatment plant. The following table shows the total average annual wastewater flows from 1993 through 2005. The average monthly flows for 2001 through 2005 are plotted in Figure 3-4.

Table 3-5 Helena WWTP Service Area Wastewater Flows	
Year	Annual Average Influent Flow (mgd)
1993	3.29
1994	3.59
1995	3.80
1996	4.10
1997	4.02
1998	3.59
1999	3.50
2000	3.55
2001	3.60
2002	3.30
2003	3.20
2004	2.87
2005	2.82

The data indicate that wastewater flows have been steadily dropping since 2001, despite an estimated 4.5 percent increase in population within the service area. Based on conversations with WWTP personnel, the higher flows in 2001 and earlier years may be due to an improperly calibrated flow meter. From 2002 through August 2005, the calibration was still being fine tuned, but the error was much smaller than prior to 2002. However, even considering some error in the flow meter, the WWTP flows since 2002 have been relatively steady despite continued growth within the service area.



Since 2001, the City has continued to slip line aging sewers and has likely seen a reduction in infiltration and inflow due to new construction materials in replacement of older sewers and in the newer portions of the collection system. In addition, many of the known cross connections from storm drains, roof drains and sump pumps in the downtown area have been eliminated. These factors have likely contributed to the lower flows.

Table 3-6 presents additional detail for the wastewater flows from 2002 through 2005.

Year	Annual Average (mgd)	Maximum Monthly Average (mgd)	Peak Day (mgd)
2002	3.30	3.86	4.79
2003	3.20	3.59	4.22
2004	2.87	3.32	3.64
2005	2.82	3.13	3.59

3.4.3. Wastewater Flow Per Capita Characteristics

A review of wastewater flow on a per capita basis was performed as part of this master plan in order to predict future wastewater flows. Using WWTP influent flow data since 1993, and assuming a steady population increase from 1990 through 1999, the per capita flow for each year since 1993 is presented in Table 3-7.

<p align="center">Table 3-7 Historic Helena WWTP Service Area Per Capita Flows</p>			
Year	Annual Average (mgd)	Population	Per Capita Value
1993	3.29	24,946	132
1994	3.59	25,059	143
1995	3.80	25,173	151
1996	4.10	25,287	162
1997	4.02	25,402	158
1998	3.59	25,518	141
1999	3.50	25,633	137
2000	3.55	25,780	138
2001	3.60	26,206	137
2002	3.30	26,350	125
2003	3.20	26,768	120
2004	2.87	27,162	106
2005	2.82	27,383	103

Using U.S. Census Bureau statistics, the State of Montana estimated that the Helena population was 26,350 in mid-2002, 26,768 in mid-2003, 27,162 in mid-2004 and 27,383 in mid-2005. This represents a 6.2 percent increase since 2000.

The data show that the per capita flow significantly decreased since the 1997 Wastewater Facility Plan was completed. That report used a per capita flow of 150 gallons per day and attributed it to a significant amount of inflow and infiltration. The current per capita flows are within the ranges experienced by most communities with predominantly domestic residential flows (typically 100 to 120 gallons per capita per day).

As discussed in the previous section, the City has made progress in decreasing inflow and infiltration within the collection system. Flow measurements performed from April 2006 through June 2006 as part of this study show a response to rainfall in sewer flows indicating that some infiltration and inflow still exists. These findings are discussed further in Chapter 5.

3.5. RECOMMENDED WASTEWATER FLOW PROJECTIONS AND DISTRIBUTIONS

3.5.1. *Introduction*

The projection of future wastewater flows is an important component of planning for future wastewater collection facilities. The predicted total wastewater flows in the study area impact the treatment plant's future needs, as well as the ability of the existing collection system infrastructure to support expansion of the system. The predicted distribution of the wastewater within the study area is used for collection system planning. The recommended flow projections and distributions are discussed below.

3.5.2. *Wastewater Flow Projection Methods*

The literature recognizes a number of methods of estimating and projecting flows for wastewater facilities. Several that might apply to the City of Helena include:

- Utilize existing per capita flow rates and future population projections
- Utilize population data coupled with employment data
- Conduct detailed flow assessment for classes of connections to the City's wastewater system.

The latter method requires a detailed review and analysis of all commercial and industrial connections. This method allows flow to be assigned to particular classes of users and can provide a direct accounting and distribution of flow within the system. The disadvantage is that the analysis is very costly and accurately projecting specific classes of uses into the planning period is difficult.

The use of employment coupled with population is an approach used in the *2004 Transportation Plan*. The literature provides values for different businesses and the wastewater attributed to each employment sector can result in a more detailed depiction of wastewater flow distribution throughout the collection system. However, this method also involves a detailed review of commercial and industrial flows.

Utilizing existing per capita flow rates and future population is the most straightforward approach to quantification of projected flows. As discussed in previous sections, the population data has been compiled by previous studies and the historical flow data from the WWTP is readily available. This approach assumes that the ratio of commercial and industrial flows compared to domestic flows remains constant for the projections. Given the existing community characteristics and the current trend in development in the Helena area, this assumption seems reasonable. Therefore, this approach is appropriate for this collection system master plan and the City's defined scope.

3.5.3. *Recommended Wastewater Flow Projections*

Based on the existing per capita flow values compared to past values, and the recent downward trend in those values, it is recommended that an average of the last five years of per capita flow be used for this master plan. This results in a value of 118 gallons per capita per year. This is much lower than what was used in the 1997 wastewater facilities plan, but it is still slightly higher than the 100 gpcd recommended by DEQ 2 – Wastewater Facilities. Using 118 gpcd provides some conservatism in the future projections.

The per capita flow value should be routinely evaluated over time and if it changes substantially, the impact on the plan projections should be evaluated. The following table summarizes the design population and resulting projected wastewater flows through the planning period.

Table 3-8 Projected Influent Wastewater Flows Using Average Per Capita Flow				
Flow Parameters	2005	2010	2015	2025
Design Population – Helena City Limits	27,484	28,495	29,509	32,167
Projected Average Annual Flow at WWTP, mgd	3.1	3.4	3.5	3.8
Design Population – Service Area	40,002	47,036	54,363	60,671
Projected Average Annual Flow, mgd	4.5	6.0	6.9	7.8

3.5.4. *Wastewater Flow Distribution*

The first two rows in Table 3-8 pertain to the area within the existing City limits and does not account for changes in the City limits due to annexation. Therefore, it accounts for new development that may occur within the City limits and associated population growth. It does not include those planned subdivisions shown in Figure 3-2 which are located outside of the existing City limits. This information is presented to project the wastewater flows to the wastewater treatment plant. This projection is dynamic and will change as the City annexes areas and connects them to the collection system. The model will allow the City to update this information as areas are annexed. Additionally, the model will allow the City to evaluate potential future annexation and growth scenarios to better define projected wastewater flow to the treatment plant.

As described in Section 3.5.2, the distribution of wastewater flow throughout the planning area was based on applying the average per capita flow of 118 gpcd to the planning area and assuming that the distribution of land use types is similar to the area within the existing City limits. A more complete discussion of the wastewater flow distribution for this Master Plan is included in Chapter 5.

A refinement of the wastewater flow distribution may be performed by the City at some point in the future, should they wish to improve the precision of the collection system model or wastewater flow projections. This could be accomplished by analysis of existing water meter data in non-irrigation months by different categories of user such as residential, commercial, and industrial. This analysis would require that the City define a category with every water service connection. Water meter data by category could then be analyzed. This would yield a percentage of total water use for each user type. These percentages could then be applied to wastewater generation.